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Leaky-layer seepage: The Verigin function revisited

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Abstract

An explicit analytical solution to the problem of steady Darcian seepage into a constant-head subsurface gallery (a straight line segment) placed in a homogeneous rock under a leaky layer of silt deposited in a reservoir is obtained. The third-type boundary condition (linear relation between the head and normal component of the Darcian velocity) along the interface between sediments and rock is tackled by the Verigin function, which satisfies the mixed boundary-value problem conditions in a domain obtained by a conformal mapping of the physical plane (quadrangle) onto an auxiliary plane. This function has three integrable singularities and, unlike Verigin's attempt to construct the second conformal mapping, we use a Signorini-type integral representation. The gallery flow rate is plotted as a function of the gallery size, location under the leaky layer, and the leakage factor, which combines the hydraulic conductivities of the rock and silt, the difference in hydraulic head between the reservoir bottom above the leaky layer and the gallery contour and the silt thickness.

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Keywords

Analytic functions, Boundary-value problems, Leaky layer, Seepage